

# The Russian National Committee on Non-Ionizing Radiation Protection (RNCNIRP) and the radiation guidelines

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## RNCNIRP's definition of "maximum permissible level of exposure to electromagnetic fields (EMF)"

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RNCNIRP takes into account the WHO definition of a human health condition: "Health is a condition of complete physical, spiritual and social well-being and not just absence of illnesses or physical defects"


By definition of RNCNIRP, the maximum permissible level of exposure to EMF is the exposure level that does not affect human health in (1) exposed persons and (2) in following generations.



## RNCNIRP's vision of the relationship between EMF effects and physiological compensation

RNCNIRP does not support the ICNIRP's point of view that "measurable biological effects that remain within the normal range of physiological compensation of the body and do not detract from the physical and mental well being of humans should not be considered as hazardous" (Bernhardt, Stolwijk, 1999).

We cannot exclude that physiological compensation can result in pathological process in various categories of population, for example, under conditions of prolonged chronic exposure to microwaves from the base stations and influence of other unfavorable factors.



RNCNIRP recognizes the non-thermal biological effects of microwaves (MW) at low intensity levels less than 1 mW/cm<sup>2</sup>

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In 52 Russian (USSR) studies selected by the RNCNIRP based on quality criteria, the unfavorable bioeffects of MW on animals were observed.

These studies have been performed in 1960–1990<sup>ties</sup> in five research institutions of Moscow, St. Petersburg and Kiev.

Animals were chronically, up to 4 month, exposed to low intensity MW at different frequencies and various modulations with power flux densities (PFD) from 1 μW/cm<sup>2</sup> to 1000 μW/cm<sup>2</sup> continuously or intermittently

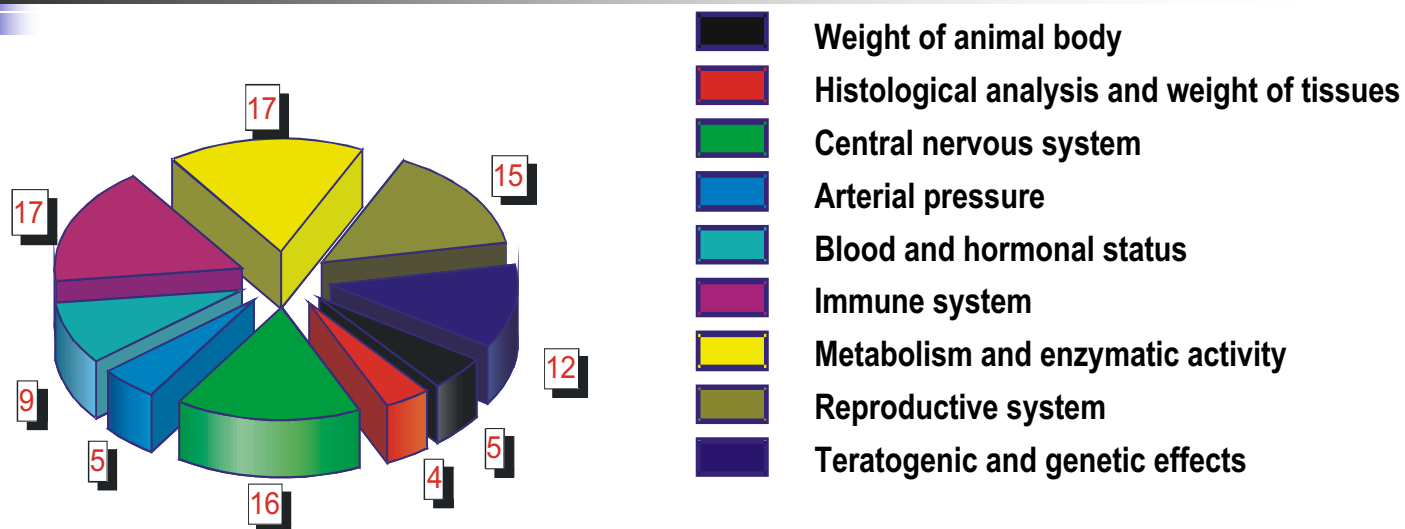


## Quality criteria

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1. Conclusions by authors are supported by the reported by the authors data
2. Appropriate statistical analysis was performed
3. Randomization of exposure conditions has been performed
4. Sham exposure was performed
5. Experiments were performed in blind
6. Methods and dosimetry are clearly described and well established in the group of the authors

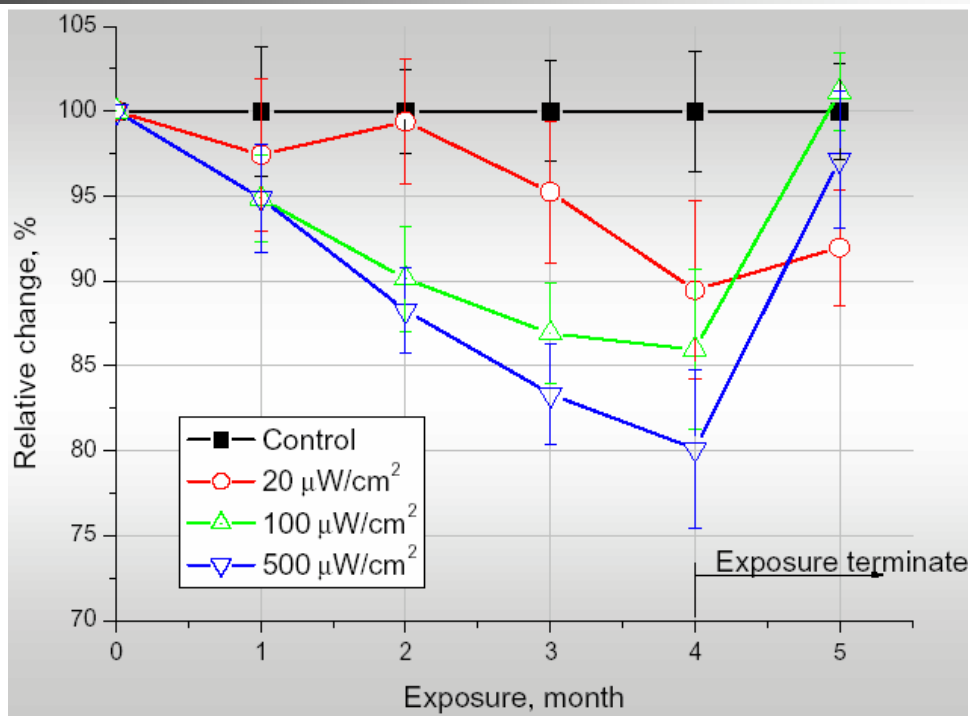
## Retrospective analysis of 52 studies with animals (mice, rats, rabbits, guinea pigs) on chronic exposure to microwaves



Number of studies

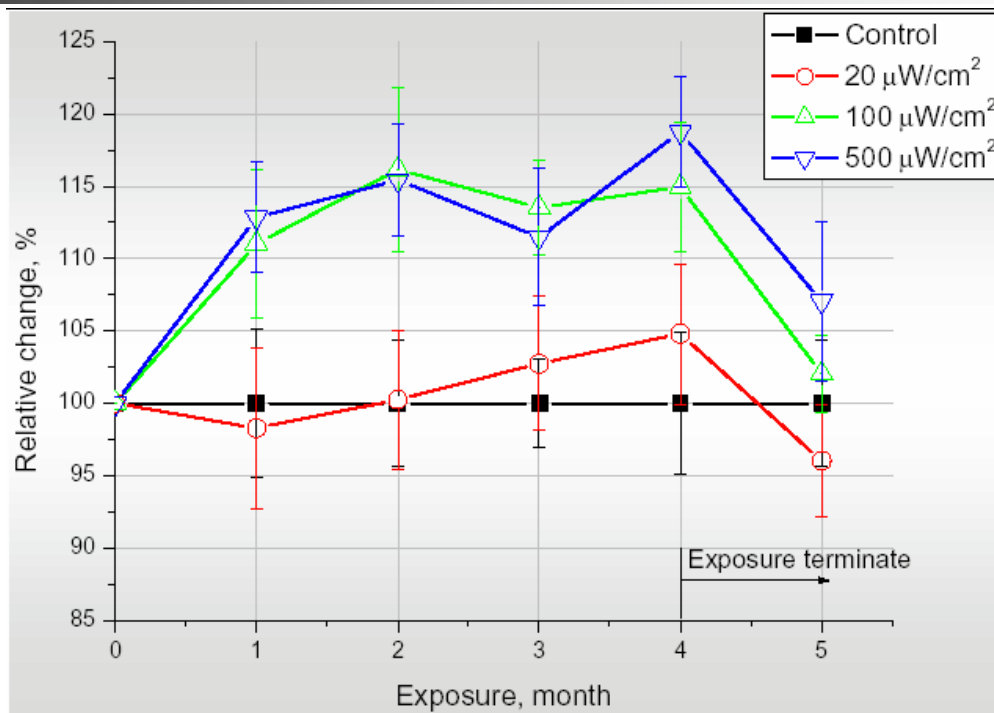
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## Succinate dehydrogenase in brain cells of rats exposed to MW, 850 MHz (Soldatchenkov et al., 1984)



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## Lactate dehydrogenase activity in blood serum of rats exposed to MW, 850 MHz (Soldatchenkov et al., 1984)



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Immune status in rats after chronic expose to MW, 2375 MHz, during 30 days (Shandala, Vinigradov, 1985)

Groups	Basophilic degranulation grade, %	Plaque producing cells, %	Complement binding antibodies (complement units)
Control	4.8±1.22	0.6±0.07	0.86±0.18
50 $\mu\text{W}/\text{cm}^2$	22.3±1.6*** p<0.001	3.34±0.05*** p<0.001	1.9±0.17* p<0.05
500 $\mu\text{W}/\text{cm}^2$	26.3±1.6*** p<0.001	5.9±0.5*** p<0.001	2.31±0.19** p<0.01

Autoimmune response in serum from MW-exposed rats (2375 MHz 500  $\mu\text{W}/\text{cm}^2$ , 30 days). Serum affected pregnant females (Shandala, Vinogradov, 1982)

Experiment conditions	No. of pregnant females	No. of deliveries	No. of offspring	No. of premature delivery females	Embryonic mortality, (%)	Day 30 offspring mortality, (%)
Intact control	10	10	7.9 $\pm$ 0.6	0	0	10.1
Non-exposed animal serum administration (lg titer 1,2 $\pm$ 0.09)	9	9	9.0 $\pm$ 0.78	0	0	17.1
Exposed animal serum administrator (lg titer 2,5 $\pm$ 0.06)	10	5** p<0.01	2.6 $\pm$ 1.04*** p<0.001	7	28	30.7** p<0.05



Summary on the MW effects (Yu. Grigoriev et al., ISTC Report, Russia, 2003 ):

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Exposure to microwaves, in the frequency range of 300 MHz – 30 GHz, PFD=100–500  $\mu\text{W}/\text{cm}^2$  in case of chronic daily exposure can induce significant and stable pathological biological reactions in animals;

PFD $\sim$ 50  $\mu\text{W}/\text{cm}^2$  represents the threshold value of the unfavorable biological effects;

PFD  $\leq$ 10–20  $\mu\text{W}/\text{cm}^2$  did not induce measurable biological changes in animals in case of chronic exposure.

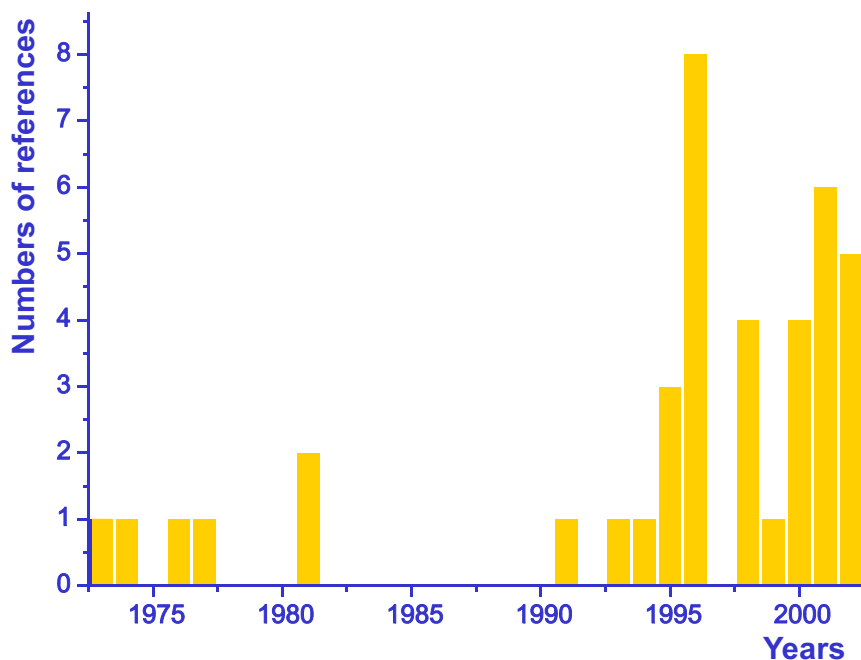


## Evidence for the role of modulation in the effects of MW/RF obtained in the Soviet Union/Russia

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- A.G. Pakhomov, M.B. Murphy, Comprehensive review of the research on biological effects of pulsed radiofrequency radiation in Russia and the former Soviet Union. In: Advances in Electromagnetic Fields in Living System, V.3 (J. C. Lin, ed.), Kluwer Academic/Plenum Publishers, New York, 2000, 265-290. ...a number of good-quality studies have convincingly demonstrated significant bioeffects of pulsed microwaves. Modulation often was the factor that determined the biological response to irradiation, and reactions to pulsed and CW emissions at equal time-averaged intensities in many cases were substantially different.
- Grigoriev Yu. G., ROLE OF MODULATION IN BIOEFFECTS OF ELECTROMAGNETIC FIELDS (SUMMARY OF RUSSIAN STUDIES), ЕЖЕГОДНИК РНКЗНИ (Annual of RNCNIRP), 2004, (review in Russian)

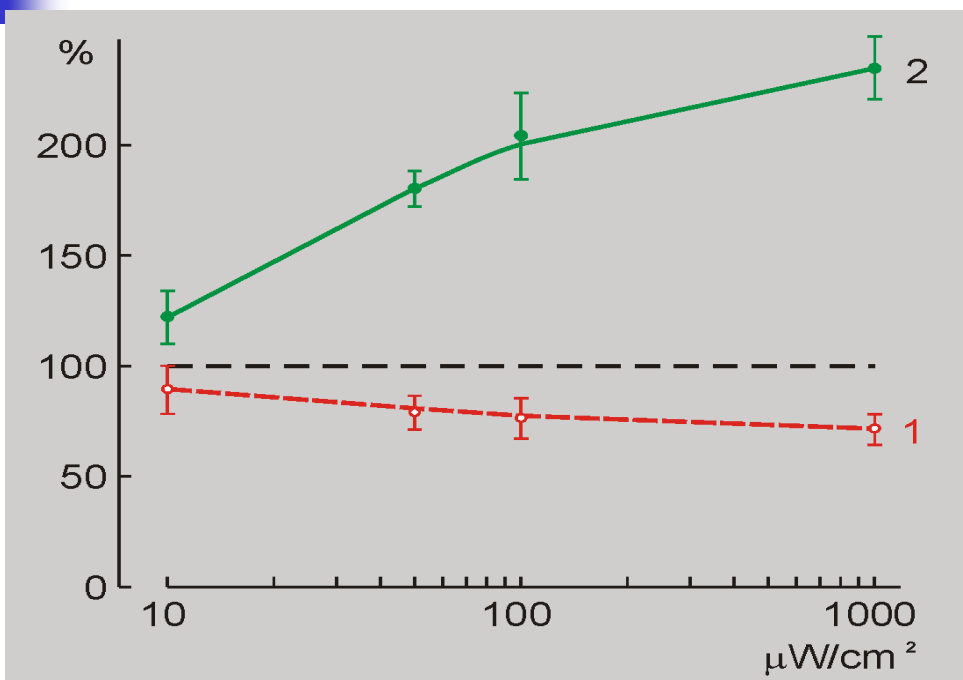
40 studies published in Russia/USSR on acute and chronic exposure of animals to MW with various modulations (Yu. Grigoriev et al., ISTC Report, Russia, 2003)



The studies were conducted in:

- Institute of Cell Biophysics, RAS
- Institute of Biophysics, Ministry of Health, Russian Federation
- Institute of Physiology, RAMS
- Institute of Medical Radiology, RAMS
- St.-Petersburg State University
- Tomsk State University.

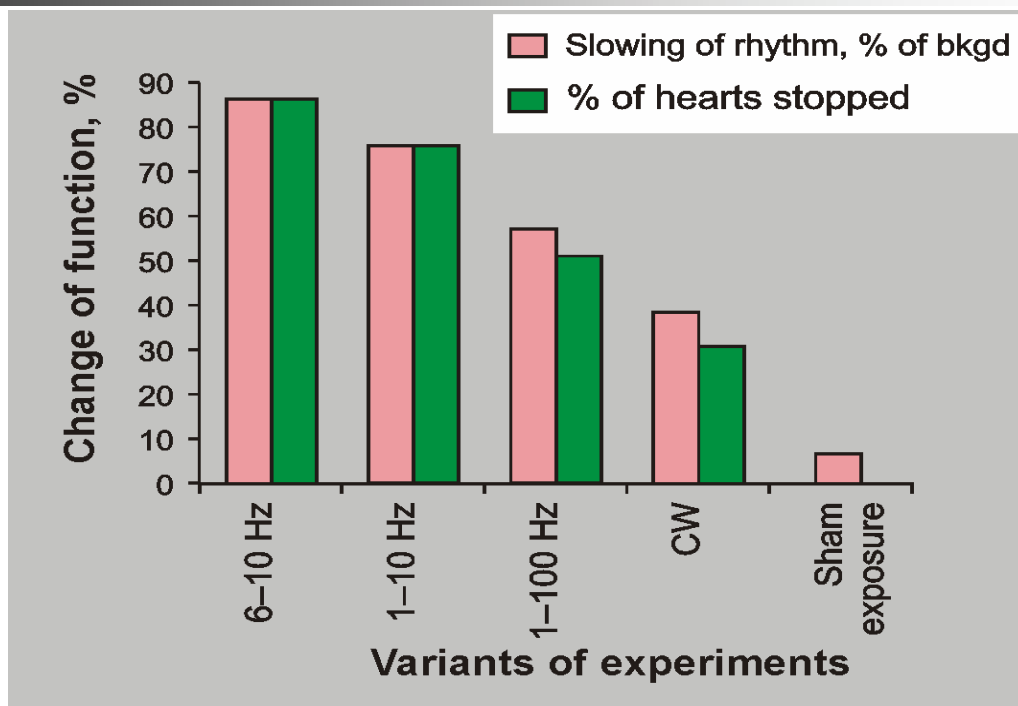
Wistar rats exposed to MW, 5 min, 915 MHz carrier frequency, 16 Hz modulation frequency (Yurinskaya et.al., 1996)



Binding of  $^3\text{H}$  muscimol (1) and  $^3\text{H}$  glutamate (2) to synaptosomes from exposed brains

Similar changes are observed during stress response and some pathologies of the central nervous system

Isolated frog hearts, MW with the carrier frequency of 9300 MHz, PFD=0.016 mW/cm<sup>2</sup>, exposure time 5–19 min, pulse modulation 1–100 Hz (Aphrikanova, Grigoriev, 1996)



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Effects of MW exposure, 880 MHz, 1 mW/cm<sup>2</sup>, within 5 days, on the audiogenic cramps in rats (%)  
(Konovalov, Serikov, 2001)

Time of repeated testing after a course of exposure (provocation of audiogenic cramps)	Animal group			
	1 (CW)	2 (4 Hz)	3 (16 Hz)	4 Sham exposure
Day 1	100	20*	20*	100
Week 1	100	20*	20*	100
Week 2	100	20*	20*	100
Week 3	100	20*	20*	100
Month 1	100	20*	20*	100
Month 2	100	20*	20*	100
Month 3	80	60	80	100
Month 4	80	60	80	100
Month 5	80	60	80	100
Month 6	80	80	80	100
Month 12	20*	80	20*	100
Month 18	37,5	66,6	25	100

\* Statistically significant, the Student t-test ( $p < 0.05$ )





## Summary on the modulation effects

(Yu. Grigoriev et al., ISTC Report, Russia, 2003)

- Exposure to modulated MW resulted in bioeffects, which can be different from the bioeffects induced by CW MW
  - Acute exposure to modulated MW at low intensities (non-thermal levels) could result in development of unfavorable effects
  - Direction and amplitude of the biological response to non-thermal MW, both *in vitro* and *in vivo*, depended on type of modulation
  - Often, but not always, modulated MW resulted in more pronounced bioeffects than continuous wave MW
  - The role of modulation was more pronounced at lower intensity levels.



## Comparison of RNCNIRP's and IEEE's points of view

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Based on the results of the chronic *in vivo* exposures performed in Russia/USSR the RNCNIRP recognizes that **non-thermal MW exposure can cause various biological effects including adverse ones** (Yu.Grigoirev, ISTC Report, Russia, 2003)

IEEE (SCC–28) considers that the strategy for the development of safety standards have to be based on the data on thermal effects of EMF as **“Thermal effect is the only established adverse effect”** (C.K. Chou, 2002)

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## Comparison of RNCNIRP's and ICNIRP's points of view

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**RNCNIRP admits a necessity of chronic EMF exposure** during development of the radiation guidelines. The studies of chronic exposures have been considered by the RNCNIRP as obligatory along with studies of the short-term acute exposures (Yu. Grigoriev, 2003).

**“ICNIRP international guidelines are based on data on short-term acute effects** to determine the approximate exposure level, or threshold level, that could potentially lead to adverse biological effects in animals” (Repacholi, Stolwijk, 1991)



## RNCNIRP anticipates further needs in discussions about the MW safety standards

- At present, **new situation arose** when significant part of population is exposed chronically (**longer than previously investigated durations of exposures**) to MW from different types of mobile communication including GSM and UMTS/3G phones and base stations, WLAN, WPAN....
- It can not be excluded that some part of population, such as **children, pregnant women and groups of hypersensitive persons** can be especially sensitive to MW exposures.
- Currently, **conclusive epidemiological studies cannot be performed** because almost whole population is exposed to different MW signals including base stations and there is no possibility to select groups exposed to specific signals or unexposed groups.
- The complains by phone users cannot be used for evaluation of health effects from mobile phones. There is a need for correlation of these complains with the data obtained in studies using the objective criteria.
- Data from the acute exposures of volunteers have very limited value because possible accumulation of effects during real chronic exposure is not evaluated.



## Role of SAR versus other EMF parameters for the evaluation of the health risks

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- Whether the SAR concept that has been widely adopted for safety standards and health risk evaluation can be used for exposure at non-thermal PFD (less than 100–500 mW/cm<sup>2</sup>)?
- How the role of other exposure parameters such as modulation, duration of exposure should be taken into account?
- Answering these questions would greatly benefit from the knowledge of the biophysical mechanisms of the non-thermal MW effects.



RNCNIRP proposes that MW guidelines should be further developed by studies based on the next priorities:

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- (1) Acute and chronic bioeffects of real MW signals as currently in use (GSM; UMTS/3G phones and base stations..) should be tested in experiments with primary human cells and animals;
- (2) Clinical observations (in the cases of accidental exposures);
- (3) Studies with volunteers under controlled conditions of chronic exposures;
- (4) Development of reliable and relevant methods to control personal exposures;
- (5) Epidemiological investigations of the postponed health effects (negative effects on various functions of organisms including neurodegenerative functions, cancer).